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UNITED STATES DEPARTMENT OF AGRICULTURE

DEPARTMENT BULLETIN No. 1245

Washington, D. C. December 22, 1924

STOCK-POISONING PLANTS OF THE RANGE

By

C. D. MARSH

Physiologist, in Charge of Investigations of Stock Poisoning by Plants
Pathological Division, Bureau of Animal Industry

CONTENTS

	Page
Prefatory Note	1
Introduction	2
Death Camas	4
Oak	6
Greasewood	7
Larkspurs	7
Wild Cherry	13
Lupines	13
Indian Turnip	15
Coffee Bean	15
Loco Plants	16
Coyotillo	21
Water Hemlock	22
Laurels	23
Milkweeds	25
Cocklebur, Clotbur	27
Western Sneezeweed	28
Baccharis pteronioides	28
Woody Aster	30
Colorado Rubber Plant, or Pingue	30
Rayless Goldenrod	31
Fern	31
Prevention of Losses	32

WASHINGTON
GOVERNMENT PRINTING OFFICE
1924

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By C. D. Marsh, *Physiologist, in Charge of Investigations of Stock Poisoning by Plants, Pathological Division, Bureau of Animal Industry.*

CONTENTS.

	Page.
Prefatory note	1
Introduction	2
The lily family (Liliaceæ)	4
Death camas (species of Zygadenus)	4
The beech family (Fagaceæ)	6
Oak (species of Quercus)	6
The goosefoot family (Chenopodiceæ)	7
Greasewood (*Sarcobatus vermiculatus*)	7
The crowfoot family (Ranunculaceæ)	7
Larkspurs (species of Delphinium)	7
The rose family (Rosaceæ)	13
Wild cherry (species of Prunus)	13
The pulse family (Leguminosæ)	13
Lupines (species of Lupinus)	13
Indian turnip (*Psoralea tenuifolia*)	15
Coffee bean (Daubentonia longifolia)	15
Loco plants (species of Oxytropis and Astragalus)	16
The buckthorn family (Rhamnaceæ)	21
Coyotillo (*Karwinskia humboldtiana*)	21
The parsley family (Umbelliferæ)	22
Water hemlock (species of Cicuta)	22
The heath family (Ericaceæ)	23
Laurels	23
The milkweed family (Asclepiadaceæ)	25
Milkweeds (species of Asclepias)	25
The composite family (Compositæ)	27
Cocklebur, clotbur (species of Xanthium)	27
Western sneezeweed (*Helenium hoopesii*)	28
Baccharis pteronioides	29
Woody aster (*Xylorrhiza parryi*)	30
Colorado rubber plant, or pingue (*Hymenoxys floribunda*)	30
Rayless goldenrod (*Isocoma wrightii*)	31
Fern	31
Prevention of losses	32

PREFATORY NOTE.

It is well known that poisonous plants cause heavy losses of range animals. Statistics in regard to these losses are not available, but from estimates made in many localities it seems probable that the average loss must be as great as 3 to 5 per cent, while in some range States it rises to much higher figures. For example, it has been estimated that in Colorado the losses amount to a million dollars annually, while sheep growers in Wyoming have estimated their annual loss as 14.6 per cent. These losses, too, are to a large extent of mature animals, those that are ready or nearly ready for the market, for the rearing of which large sums have already been spent.

The importance of these severe losses has been recognized by the United States Department of Agriculture, and extended investigations and experiments have been undertaken to determine what plants were poisonous and under what

[1] This bulletin is a revision of and supersedes Department Bulletin 575, issued July 23, 1918.

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conditions poisoning took place, and to formulate methods for preventing these deaths. This work has involved prolonged study, and is still in progress. Some very definite results have been obtained, however, and it has been shown that the heaviest losses are due to a comparatively small number of plants. If the stockmen and herders can recognize these plants and will act upon the information contained in the bulletins which have been published on the subject, there is no doubt that most of these losses can be avoided.

This bulletin has been prepared with special reference to the needs of livestock producers. It was realized that many stockmen are not botanists and might not recognize plants through a technical description. In order to assist in recognition, many of the pictures of plants have been reproduced in colors.

The bulletin was published in 1918 as Department Bulletin 575 and proved to be so popular that it was reprinted the following year. Inasmuch as there have been considerable additions to our knowledge of poisonous plants since the bulletin was issued, it has seemed wise to revise it and bring it more completely up to date. A number of pictures of poisoned animals have been added.

This is not intended as a complete manual of the subject. For detailed information other publications should be consulted. The United States Department of Agriculture has issued a considerable number of publications relating to specific plants. A list of such publications is given at the end of this bulletin.

Plates I, V, XI, XXII, XXIII, and XXX are from paintings by F. A. Walpole, in the collection of the United States National Herbarium.

J. R. MOHLER, *Chief of Bureau.*

INTRODUCTION.

Poisonous plants have been the cause of heavy losses among livestock on the range. Stockmen generally have recognized the fact, but in the past comparatively little has been done to avoid the losses. The first intimation of trouble has ordinarily been the finding of the carcasses, and while the men handling the stock have felt reasonably sure that certain plants were responsible, their knowledge of the plants was very meager, and the evidence against any particular plant was frequently insufficient. It was noticed that these losses were more apt to occur in certain seasons than in others, and it was assumed in some cases that the plant was more poisonous at some stages of growth than at others. Many of the stockmen were entirely uncertain as to what plant caused the damage, and it was common to speak of the source of the trouble as "poison weed," in a general way, without any very definite idea as to what particular weed was responsible for the loss. Moreover, the investigations which have been carried out on the subject of range poisoning plants have necessarily been somewhat narrow in scope. There is a popular misconception in regard to the quantity of a poisonous plant necessary to produce illness. It seems to be the general belief that any plant possessing poisonous properties must be violently toxic. It is not unusual to hear stories of poisoning of domestic animals by a very few leaves of a poisonous plant. As a matter of fact, most of the stock-poisoning plants in the United States produce illness only when eaten in considerable quantity. This explains why so many experimental tests of animals with poisonous plants have failed, since some of these plants can be eaten with no apparent harm, provided the quantity eaten at any one time is not sufficient to produce toxic effects.

Many of the problems of plants poisonous to livestock seem to be largely peculiar to North America. Although similar plants occur

in the eastern continents, very little information can be drawn from European sources to aid the American stockman.

For several years the United States Department of Agriculture has been carrying on a series of experiments with poisonous plants, and has accumulated a considerable body of information, which, although necessarily incomplete, will be, it is hoped, of service to men handling livestock upon the open range.

It appears from these researches that, while the total number of poisonous plants growing in the West may be very large, the number to be dreaded by the stockmen is comparatively small, and in most cases it is not at all difficult to identify the plants which are to be avoided. Of course, most stockmen are not botanists and are not interested in the botanical distinctions of plants. Most of them, however, are good observers and can readily recognize these plants if the salient characteristics are brought before them in a manner which they can understand.

With the continued reduction of the area of stock ranges and the increasing value of livestock, the owners are of necessity handling the animals with greater care. The time has passed when a man will buy a few cows, turn them loose, and pay no more attention to them except to brand the calves and occasionally round up a few of them for market. It is becoming necessary for stock owners to be in constant touch with their animals upon the range, and it is no longer probable that a large number will die and the fact become known to the owner only after the lapse of weeks or months. Most of the mountain stock ranges at the present time are under the general direction of the Forest Service, and its officers are constantly patrolling the territory under their direction, so that between this supervision and the riding by the employees of the stock owners, cattle and horses upon the range are kept under almost constant observation. Sheep, of course, have always been under the immediate care of a herder, and probably will continue to be attended to in the same general way.

Extensive acquaintance by the author with the conditions on the western ranges has shown that while harmful plants are known and avoided by some men, there are large regions in which these plants have never been recognized, in spite of the fact that losses have occurred year after year.

The object of this publication is to present in a brief and intelligible form such a description of the common or more important plants as can be understood by a person not in the habit of using technical terms. With this description is given a brief statement of the symptoms produced by the plant, the time at which the losses may be expected to occur, and the means, so far as they are known, of avoiding them. It is not intended to give any complete description of the plants or their effects. For this, reference must be made to the more detailed reports upon specific plants.[2] In regard to most of these our knowledge is at present on a firm basis of experimental proof. It has seemed best, however, to add to the list some plants which undoubtedly produce poisonous effects, but which have never been subjected to detailed experimental study.

[2] A list of such publications appears at the end of this bulletin.

There are many other plants which, under some conditions, may cause sickness or death, but it has been thought best to limit the descriptions to those which are widely distributed and especially important.

THE LILY FAMILY (LILIACEÆ).

DEATH CAMAS (SPECIES OF ZYGADENUS).

The larger part of the losses of sheep from poisonous plants during the spring and early summer months is due to the various species of Zygadenus, or death camas.

Plate I, a picture of *Zygadenus venenosus*, gives a clear idea of the general appearance of these plants. All the species have green, grasslike leaves, which, at the early stages of growth, are not readily distinguished from the grasses among which they may be growing. When in blossom, however, the yellowish-green or yellowish-white heads of flowers are rather conspicuous. Some of these plants grow in fairly dense masses, covering several acres. All grow from a bulb which, in most cases, is rather deeply buried, and is not likely to be pulled up by grazing animals.

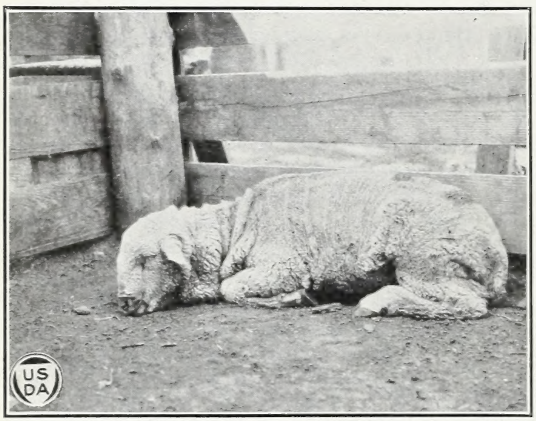

FIG. 1.—A sheep very sick from eating foothill death camas (*Zygadenus paniculatus*).

A number of popular names have been applied to these plants, but death camas and poison sego are those most commonly used. In the Pacific States perhaps lobelia is used more than any other name. It would probably be well if there were a general adoption of the term death camas.

The botanists recognize a number of species, but there are four with which the western stockman is most likely to come in contact.

GRASSY DEATH CAMAS (ZYGADENUS GRAMINEUS).

The grassy death camas, *Zygadenus gramineus*, is especially common in Montana, Wyoming, and the neighboring States, and is responsible for heavy losses in the spring. It starts before the grasses and matures in May and June. The plant and fruit are shown in Plate II.

FOOTHILL DEATH CAMAS (ZYGADENUS PANICULATUS).

Zygadenus paniculatus, known as the foothill death camas, is the common species in the intermountain region. It has a compound flower stem, so that the group of flowers is more extended than in the other species. This species causes much sickness, but not so many deaths as does the grassy death camas.

DEATH CAMAS (ZYGADENUS VENENOSUS)

The Meadow species of death camas growing most abundantly in the Pacific States

Meadow Death Camas (Zygadenus venenosus).

While the foothill death camas grows on gravelly ridges and dry areas, the meadow death camas (*Zygadenus venenosus*), shown in Plate I, grows in damp meadows. It is the common death camas of the Pacific States and causes much trouble, though not so many deaths as the grassy death camas.

Mountain Death Camas (Zygadenus elegans).

In gullies and damp places in the mountains above 8,000 feet there is found another death camas, *Zygadenus elegans*, sometimes in considerable masses. While this closely resembles the other species, it is only slightly poisonous and probably never injures animals on the range.

Death Camas Poisonous to All Animals.

Cattle may be poisoned by death camas, and horses are frequently made sick by it. Most of the losses, however, are of sheep. There have been many serious cases of human poisoning when children or others have eaten the bulbs.

Fig. 2.—A locality in the State of Washington, where 900 sheep out of a flock of 1,900 were victims of grassy death camas.

Symptoms of Zygadenus Poisoning.

The prominent symptoms of Zygadenus poisoning, as seen upon the range, are frothing at the mouth, nausea accompanied by vomiting, great weakness accompanied sometimes with nervousness and resulting in collapse of the animal (fig. 1), which may lie without food for hours, or even days, before death terminates the case. It is not unusual for large numbers of sheep in a band to be poisoned by Zygadenus, and in such case the result is almost always heavy loss. (See fig. 2.) Perhaps more cases of Zygadenus poisoning have been reported from Montana than from other States, but this is simply because the cases have been under observation in that locality; the losses are probably just as heavy in Utah, California, and elsewhere.

Treatment for Zygadenus Poisoning.

There are no medicinal remedies which can be used effectively for Zygadenus poisoning. The important thing is to avoid the possibility of the sheep eating any large quantity of the plant. Unfortunately, the plants are quite toxic, so that comparatively small quantities may produce harm.

THE BEECH FAMILY (FAGACEÆ).

OAK (SPECIES OF QUERCUS).

Throughout the grazing regions of the West there is a very general belief in the poisoning properties of oak leaves, more particularly in regard to their supposed toxic properties for cattle. It is quite generally thought that poisonous effects are produced in the spring, when cattle are eating the buds and young leaves. This belief applies especially to the Gambel oak (*Quercus gambellii*), which is a common scrub oak of Colorado, Utah, and New Mexico, and to the shinnery oak (*Quercus havardi*), a low shrub in eastern New Mexico and western Texas. Extended experiments have been carried out upon these plants by the United States Department of Agriculture.

FIG. 3.—A heifer suffering from poisoning by the scrub oak of Utah.

It has been found that when cattle eat very heavily of oak forage, especially in the spring, when the foliage is tender and attractive and the grasses have not started, many animals contract so-called "oak poisoning," showing constipation, black and bloody feces, emaciation, and surface swellings on the body. This condition is so serious as sometimes to cause a considerable number of fatalities. It is not true, however, that oak forage is necessarily harmful. In fact, on many ranges the oaks furnish a very important element in the feed of cattle, and animals generally come from oak ranges in the fall in fine condition. It has been clearly shown that an exclusive diet of oak is likely to result in some sick animals and consequent losses. If there is other forage with the oak, no bad results will follow. If cattle, in poor condition as the result of short feed in the winter, are turned upon an oak range where there is little grass, some losses are pretty sure to follow. It pays to feed cattle in the winter

FIG. 4.—A "shinnered" bull in western Texas.

GRASSY DEATH CAMAS (ZYGADENUS GRAMINEUS).

This is the plant that causes especially heavy losses of sheep in Montana and Wyoming.

AN OVERGRAZED OAK-BRUSH RANGE.

This shows how cattle, when other forage is scanty, "trim up" the oaks.

so as to keep them in good condition, and then they are not likely to overeat when they come in contact with oak.

Plate III shows an overgrazed range in the oak belt of the Wasatch Mountains. It shows how cattle, when driven by lack of other feed, will eat oak leaves and twigs as high as they can reach. Figure 3 shows a heifer poisoned by the common scrub oak of Utah, and Figure 4 a "shinnered" bull on the plains of western Texas.

THE GOOSEFOOT FAMILY (CHENOPODIACEÆ).

GREASEWOOD (SARCOBATUS VERMICULATUS).

Greasewood (*Sarcobatus vermiculatus*) is a well-known plant common on the alkaline plains of the West. It is a spiny shrub growing from 3 to 9 feet in height, with narrow, fleshy leaves not exceeding about 1½ inches in length. In Figure 5 is shown a plant, and in Plate VIII are shown branches with leaves and staminate flowers.

FIG. 5.—Greasewood (*Sarcobatus vermiculatus*) plants on the range.

While greasewood is grazed by sheep on the winter range with no bad effects (as a matter of fact the plant forms an important element in the winter forage), there have been, under some conditions, severe losses of sheep. If very hungry animals eat a large quantity in a short time, fatal results may follow. Cases are known where several hundred have been lost.

Figure 6 shows a sheep which was killed by an extract of greasewood. The picture was taken shortly before its death. The poisonous effects are produced by the sodium and potassium oxalates in the plant.

THE CROWFOOT FAMILY (RANUNCULACEÆ).

LARKSPURS (SPECIES OF DELPHINIUM).

A great many species of larkspurs grow in the western stock ranges, and they are widely distributed throughout the mountain regions which are used for pasturage. These plants when in blossom are very easily recognized by the peculiar form of the flower. Before blossoming there are a few plants with which they may be confused by a person who is not versed in botany, but it is not

particularly difficult for the ordinary observer, after a little experience, to recognize larkspurs in all stages of growth. While there is a large number of species, all may be grouped under the two general heads of tall larkspurs and low larkspurs.

Tall Larkspurs

The tall larkspurs in their maturity reach a height of 4 or even 6 or 8 feet. They are perennials and grow in great abundance in the high mountain regions, ordinarily preferring damp and sheltered places, such as are found in mountain valleys and under trees. Under some circumstances, however, they may grow in considerable abundance in the open. All the tall larkspurs agree in the form of the leaf, which is well illustrated in Plates IV and V. The flowers, with the spur from which the plant gets its name, are very characteristic in their form and in most species vary in their colors through various shades of violet, blue, and purple. Before the plants are mature the leaves may be confused with those of the wild geranium, which in many places grows abundantly with the tall larkspur, but the different habit of the plant makes it comparatively easy to distinguish between them.

Fig. 6.—A sheep which was killed by extract of greasewood.

It is more difficult to distinguish between aconite and larkspur, because the leaves of the aconite are almost identical in form with those of the larkspur, and the habit of the plant is similar. The leaves of aconite have shorter petioles (leaf stalks) than those of larkspur.

Species of tall larkspurs are found in all the mountain ranges of the West at high elevations, growing up as high as the timber line. Sometimes they are found as scattered clumps of plants, but frequently they grow in large masses.

Plate IV shows the leaf, flower, and seed pod of the tall larkspur which is most common in Montana and adjoining States, known to botanists as *Delphinium cucullatum*. This does not ordinarily grow to any considerable height—perhaps not more than 4 feet—and the flower is less conspicuous than in most of the tall larkspurs. The color is ordinarily described as a grayish purple, due to the fact that there is considerable white in connection with the violet-purple shades of the corolla. This plant is responsible for most of the deaths of cattle by larkspur in Montana. Plate V shows the tall larkspur of the Pacific coast region (*Delphinium trolliifolium*); it has a much more conspicuous and beautiful flower than *D. cucullatum*.

TALL LARKSPUR (DELPHINIUM CUCULLATUM)

This is the tall larkspur which is abundant in Montana and adjoining States. It differs from the other tall larkspurs in the smaller size and less conspicuous coloring of the flowers

TALL LARKSPUR (DELPHINIUM TROLLIIFOLIUM)

This is the tall larkspur of the Northwest, and is conspicuous because of its large and beautiful flowers

Delphinium barbeyi is perhaps the most widely distributed species of the tall larkspurs and is the plant which causes the greater part of the tall-larkspur losses in Colorado, Utah, and some other localities. Figure 7 shows the leaves and blossoms of this species, and Figure 8 a group of the plants in blossom.

In most cases the tall larkspurs blossom during the summer months and do not die down until they are broken by the snows of the early fall. The exact time of blossoming differs with the species and with the places in which they occur. In the mountains of Colorado the blossoming period is ordinarily in July, and the seeds are formed in August, after which the plant commences to dry up. The leaves of the tall larkspurs lose their poisonous properties after blossoming, so that in most localities the cases of poisoning from these plants occur in the spring or early summer. In the case of some species, however, especially in localities where the snowfall is heavy and remains late in the season, and in certain parts of the Sierras the period of blossoming continues late into the summer, so that poisoning cases may occur at any time during the season.

FIG. 7.—Tall larkspur (*Delphinium barbeyi*), leaves and flowers.

The seeds of the tall larkspurs are very poisonous, but they are not eaten to any extent by cattle.

ACONITE (ACONITUM COLUMBIANUM).

Plate VI is a picture of the ordinary aconite and is inserted in order that it may be compared with the pictures of the larkspur, and the similarity noted. Aconite, as is well known, is a poisonous plant, but somewhat extensive experimental work by the Department of Agriculture has demonstrated that it does not poison livestock on the range. It is important, therefore, that this plant should be distinguished from larkspur, because in some localities it occurs in great abundance, while larkspur is comparatively rare. This is true of certain parts of the Yellowstone Park, where in some localities the swampy regions are blue with aconite in the summer months, while the larkspur is only rarely met with. In other parts, however, like the region between the Yellowstone Lake and the Grand Canyon, the larkspur is very abundant and the aconite comparatively rare.

Flowers of the aconite have the peculiar form from which the plant has been known as "monkshood," and in most regions they are much darker in color than the larkspurs. Generally speaking, in the

aconites of the West the flowers are of a very deep blue. There are localities, however, in which the shades of color are much lighter, almost the exact shades of the violet and purple that are more typical of the larkspurs, while in other places the flowers are almost white.

The roots of the tall larkspur are long, tough, and fibrous, while the roots of aconite are short and tuberlike, with golden-yellow rootlets. The stem of the tall larkspur is hollow, while the stem of the aconite is pithy.

Low Larkspur.

Plate VII is a typical picture of the low larkspur which is most widely spread throughout the western ranges. This species is *Delphinium menziesii*, probably the most destructive of the low larkspurs, due to the fact that it occurs in such enormous masses. There

FIG. 8.—A group of plants of the tall larkspur (*Delphinium barbeyi*), growing in natural surroundings. The white background brings out the plants more clearly. This species is the most widely distributed of the tall larkspurs and is responsible for greater losses of cattle than any other species. It extends from Colorado to the Sierras.

are regions in Colorado and Utah where many acres are almost carpeted with these plants. They occur early in the spring, immediately after the snow disappears, growing more rapidly than the grasses, so that in some regions they seem for the time almost to preempt the soil. These low larkspurs blossom comparatively early in the season, and in Colorado *D. menziesii* dries up and disappears not far from the first of July. Consequently the cases of poisoning from low larkspurs occur almost entirely in May and June.

It will be noted that the leaves of the low larkspurs are quite different from those of the tall larkspurs, but are easily recognized after one becomes fairly familiar with them.

There is another low larkspur, occurring quite commonly in Montana, *Delphinium bicolor*, which is typical of somewhat lower

ACONITE (ACONITUM COLUMBIANUM)

The aconites grow in close proximity to the tall larkspurs, and are frequently confused with them. The leaves are almost identical in form, and the plants grow to the same height. They can, however, be distinguished by the form and color of the flowers. Although poisonous plants, the aconites do not poison cattle

LOW LARKSPUR (DELPHINIUM MENZIESII)

This is the most common of the low larkspurs, extending from Colorado to the Sierras, and causes heavy losses of cattle

GREASEWOOD (SARCOBATUS VERMICULATUS).

Branches showing leaves and staminate flowers.

PRAIRIE LARKSPUR (DELPHINIUM VIRESCENS).

The white larkspur of the plains, which is found as far south as Texas. It is probably responsible for occasional losses of cattle.

altitudes than *D. menziesii* and apparently never grows in sufficiently large masses to be dangerous. The low larkspur *D. andersonii*, growing in Nevada, California, and Oregon, causes many fatalities.

The low larkspurs are poisonous throughout the whole period of their lives, while the tall larkspurs gradually lose their poisonous properties after blossoming.

In Plate IX is shown a larkspur with white blossoms, *Delphinium virescens*, which is quite common in the plains regions east of the Rocky Mountains. This plant probably rarely occurs in sufficient abundance to cause harm, but there is reason to think that at some seasons it has occasioned the death of a considerable number of cattle.

Parts of Larkspurs Poisonous.

There is a general belief throughout the West that it is the roots of the larkspur which are particularly poisonous. Experiments have proved conclusively, however, that the different parts of the plant are equally poisonous, with the exception that the seeds are especially so. Probably in almost all cases of larkspur poisoning the trouble is caused by eating the leaves, sometimes with the flowers. As was said before, most of the cases of larkspur poisoning occur in the spring or early summer.

Animals Poisoned by the Larkspurs.

While horses can be poisoned by corral feeding of larkspurs, there is reason to think that if left to themselves upon the range they never eat enough of these plants to do any harm. Sheep eat the larkspurs freely without suffering any evil consequences. There is quite a general belief in many regions of the West that losses of sheep have been caused by larkspur feeding, but extensive experiments upon a large number of species, and in different regions, have proved conclusively that sheep can be grazed upon larkspur without any risk whatever. In fact, it may almost be said that larkspur furnishes good forage for sheep. The losses from larkspur poisoning, then, are altogether with cattle, and these losses are very heavy.

Symptoms of Larkspur Poisoning.

While the result of corral feeding shows that there are a number of preliminary symptoms, as animals are noticed upon the range the first symptom commonly observed is the sudden falling of the animal, accompanied by violent struggles. The animal is unable to rise, but after a few moments may get upon its feet and walk away, and show no further symptoms. In more acute cases of poisoning the first fall will be followed by a second, and that possibly by a succession of falls, which in severe cases of poisoning are followed by complete prostration, vomiting, and death. Plate X shows some of the attitudes assumed by a severely poisoned animal.

Treatment of Cattle Poisoned By Larkspur.

Inasmuch as death from larkspur poisoning is caused by respiratory paralysis, it is very important, if the animal is found poisoned by this plant, that immediate means shall be taken to relieve the

difficulty in respiration. In their struggles animals poisoned by larkspur ordinarily throw themselves with their heads downhill, and in this position the stomach and intestines press upon the lungs and seriously interfere with the function of respiration. If while in this position the animal should vomit, some of the regurgitated material is very apt to fall back into the windpipe and cause asphyxiation. When, therefore, an animal is seen to fall from larkspur poisoning, it should be turned about with its head uphill and erect and should then be left undisturbed. It is also desirable under such conditions to give the physostigmine remedy hypodermically, as recommended in Farmers' Bulletin 988. The remedy has the following formula:

Physostigmine salicylate	1 grain.
Pilocarpine hydrochlorid	2 grains.
Strychnine sulphate	½ grain.

This formula would apply to an animal weighing 500 or 600 pounds. For a large steer or cow of 1,000 pounds or more the dose should be twice that given in the formula These materials can be obtained from any dealer in drugs. The physostigmine salicylate and pilocarpine hydrochlorid are furnished in veterinary hypodermic tablets, each containing one-half grain of physostigmine salicylate and 1 grain of pilocarpine hydrochloride. The strychnin sulphate can be obtained in tablets each containing one-half grain. These dissolve easily, and it is well to have two or three doses ready in small, homeopathic bottles. For yearlings one should use two of the physostigmine-pilocarpine tablets and one of the half-grain strychnine tablets dissolved in an 8-dram homeopathic bottle one-third full of water; for full-grown cattle four of the physostigmine-pilocarpine tablets and two of the strychnine tablets dissolved in an 8-dram bottle two-thirds full of water should be used.

FIG. 9.—Sheep poisoned by cherry, gasping for breath.

It is best to use an all-metal hypodermic syringe. This can be easily cleaned by boiling. The form which has been found most useful for the field is that known as the Quitman syringe. In this the needles are carried in the hollow piston, and a case is therefore unnecessary. The syringe should be of the 10-centimeter size, which holds one-third of an 8-dram bottle of water, so that the remedy can be given to yearlings in a single dose, while for mature cattle the syringe must be filled twice. The needle is most conveniently inserted in the shoulder. There is little doubt that prompt treatment of animals poisoned by larkspur will result in the saving of most of the cases.

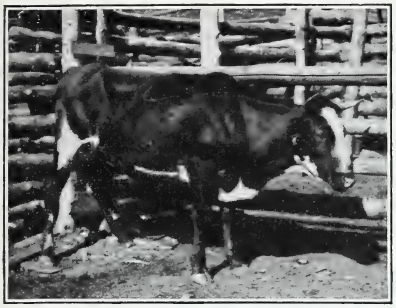

FIG. 1.—HIND LEGS BRACED APART IN THE EFFORT TO REMAIN STANDING.

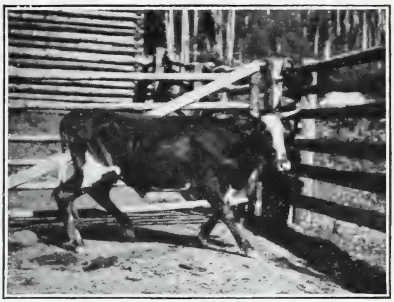

FIG. 2.—STAGGERING.

FIG. 3.—REMAINING ON FEET WITH GREAT DIFFICULTY.

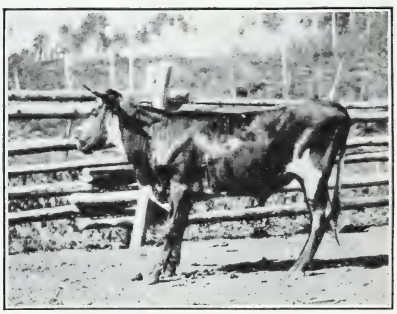

FIG. 4.—BACKING IN THE MANNER CHARACTERISTIC OF LARKSPUR POISONING.

FIG. 5.—JUST BEFORE FALLING.

FIG. 6.—FALLING IN THE MANNER TYPICAL OF LARKSPUR POISONING.

A STEER SEVERELY POISONED BY LARKSPUR.

82963°—24——2

WILD CHERRY (PRUNUS NANA)

The wild cherries grow in great abundance upon the stock ranges of the mountain regions and sometimes occasion quite heavy losses

LUPINE (LUPINUS SERICEUS)

Many of the species of Lupine are poisonous, and are the cause of the larger part of the heavy losses of sheep during the late summer and fall months. Sheep are most likely to be poisoned by eating the pods and seeds

THE ROSE FAMILY (ROSACEÆ).

WILD CHERRY (SPECIES OF PRUNUS).

For years there have been persistent reports of poisoning, especially of sheep, from eating wild-cherry leaves. There has been great difficulty in proving the truth of these stories, for it has frequently happened that of several bands going through a mass of wild cherry, possibly only one would suffer, while the others would go through with no cases of poisoning. A large number of experiments have been performed with wild-cherry leaves, many of which have been without results. Investigations by the department, however, have verified the statement that the leaves of wild cherry may be extremely poisonous, and there seems to be no doubt that, under certain circumstances, animals may be killed by eating this plant. These cases ordinarily occur along drives that are bordered by wild cherry and where there is very little else for the animals to eat.

It has been found that the rather widespread idea that cherry leaves are specially dangerous when wilted is erroneous.

Sheepmen should by all means avoid, if possible, trails that are lined with wild cherry, and if it is necessary to drive over these trails, they should take great care that the animals are well supplied with food before commencing the drive. Poisoning from wild cherry is due to prussic acid, and death results very quickly. (Figs. 9 and 10.) No treatment is likely to modify the results.

FIG. 10.—Sheep in the last stages of cherry poisoning.

Plate XI shows one of the wild cherries of the West.

THE PULSE FAMILY (LEGUMINOSÆ).

LUPINES (SPECIES OF LUPINUS).

The lupines are among the most conspicuous of the flowering plants upon mountain ranges. They are scattered in a very large number of species practically over all the grazing regions. They are known under a great variety of common names, among which are "blue pea" and "wild bean."

The picture of *Lupinus sericeus*, Plate XII, will serve for the identification of any of the lupines. The form of the leaf and the color of the flower, ordinarily shades of purple or blue, readily distinguish this plant from others growing in the same neighborhood. The seeds are especially poisonous, and most cases of poisoning result from eating the pods containing seeds. The pods alone, however, may poison, and sometimes sheep are poisoned by the leaves, or by the leaves in combination with the seed pods.

The losses from lupine poisoning are mostly of sheep, although some horses are poisoned. It is probable that the lupines are the principal cause of sheep losses in the late summer and fall months. It is not by any means to be understood that sheep are always poisoned when they come upon a patch of lupine, for bands of sheep may feed through lupine for a whole season without any harm. When, however, a hungry band comes upon a patch of lupine at the time when the pods are filled with seeds, poisoning frequently occurs. Cases of poisoning sometimes happen when sheep are taken from the cars and allowed to graze freely upon lupine. Many cases of poisoning have occurred when the sheep are brought down from the mountains in the fall. If during that passage the band is overtaken by a snowstorm, sometimes it will feed freely upon the lupine pods which remain above the snow, and heavy losses may occur. It is not unusual for several hundred out of a band to be killed by lupine poisoning. These losses are not confined to any one State, but occur in most of the Western States where sheep are grazed upon the range. While there is definite experimental proof of the poisonous properties of some of the lupines, others are known to be not poisonous. It is difficult, however, even for one trained in botany to distinguish between these, so that the wise herder will endeavor to keep his sheep away from all lupines when the plants are in pod.

FIG. 11.—A range sheep poisoned by lupine.

SYMPTOMS OF LUPINE POISONING.

The symptoms of lupine poisoning resemble in many respects those produced by some other poisonous plants. There is frothing at the mouth, but in addition the animals run about in a frenzy, butting against any opposing object in a way which seems to be characteristic of this disease. Figure 11 shows a range sheep poisoned by lupine. This was one of a large number affected as they were coming from summer range. In Figure 12 is shown a poisoned animal, sheep 253, butting against the side of the pen. This is typical of lupine poisoning.

TREATMENT OF LUPINE POISONING.

No medicinal remedies have been found for cases of lupine poisoning. The only thing for a sheep herder to do is to make certain in advance that the animals under his care shall not come upon a patch of lupine in pod at a time when they are particularly hungry.

INDIAN TURNIP (PSORALEA TENUIFLORA).

A very common plant on the plains, supposed to be poisonous under some circumstances.

COFFEE BEAN (DAUBENTONIA LONGIFOLIA).

The seeds have caused losses of sheep and goats.

INDIAN TURNIP (Psoralea tenuiflora).

Psoralea tenuiflora, known as Indian turnip, is a very common plant on the plains of Colorado, Wyoming, and Montana, and is found as far east as Illinois. There have been many reports of its poisonous effects on horses and cattle, and it is said to have been used by the Indians for poisoning fish. Several species of Psoralea have been examined by chemists, and have been found to contain poisonous principles. One of the species has been popularly known as a loco weed. There has been no experimental work to prove its effect on domestic animals, and as it is distasteful to grazing animals it can not, under any circumstances, be considered an important poisonous plant. There is good reason, however, to suspect it of sometimes

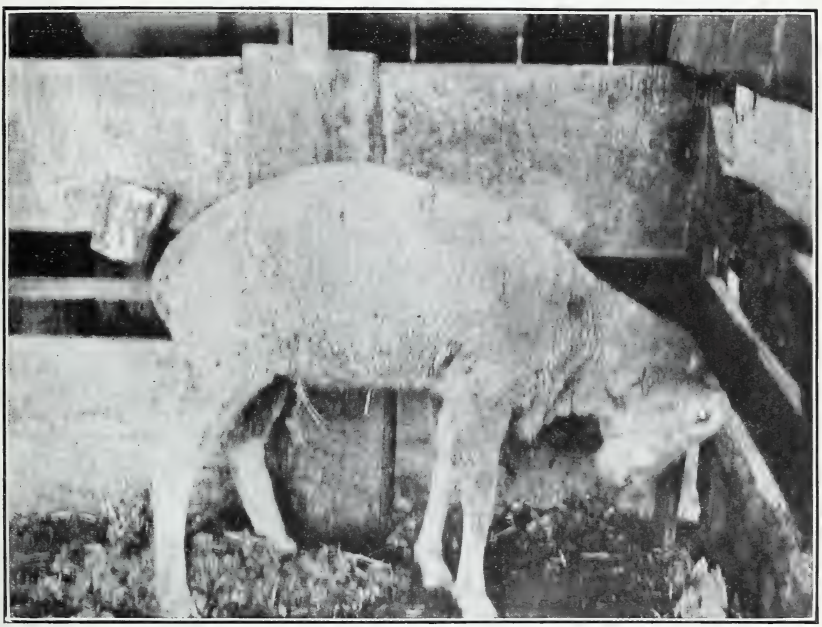

FIG. 12.—A sheep poisoned by lupine in the typical attitude of butting against some object.

being harmful, if animals are forced to eat it by reason of poor pasturage or because it is present in large quantity in hay. Plate XIII is a picture of this plant.

COFFEE BEAN (Daubentonia longifolia).

The coffee bean (*Daubentonia longifolia*), shown in Plate XIV, is a shrub growing in the Gulf region and extending as far north as the northwestern border of Texas. It likes to live with "its feet in the water" and is found in great profusion along ditches and sluggish streams in southern Texas.

The leaves are alternate, with 12 to 60 leaflets, and the flowers are lemon yellow. The pods, as shown in the illustration, have four wings and the seeds are separated from one another by cross partitions in the pods.

So far as known, the green plant does no harm. The seeds are poisonous and a sheep may be poisoned by a little more than an ounce or killed by something less than 2 ounces. The pods have little if any poison. Cases of poisoning occur in the winter on areas where feed is scanty.

All the known cases of poisoning have been of sheep and goats. Animals eating the seed show depression, generally accompanied with diarrhea. In fatal cases the symptoms are not especially pronounced; but the animals become weak, have labored breathing, and die with very little struggling. Considerable time elapses between the feeding and the appearance of symptoms, sometimes as much as 24 hours. The symptoms, too, may continue several days, so that poisoned animals require special care until after complete recovery. Figure 13 shows a sheep poisoned by the coffee bean.

FIG. 13.—A sheep poisoned by coffee bean (*Daubentonia longifolia*).

LOCO PLANTS (SPECIES OF OXYTROPIS AND ASTRAGALUS).

Without any doubt the most destructive of all the poisonous plants are those going under the general name of loco. That extensive losses of domestic animals have been caused by loco plants has been claimed for a long time, but it is only within the last few years that exact evidence, by careful experiments, has shown definitely that these plants produce the effect which has been popularly ascribed to them. A great deal of interest attaches to these plants because of their wide distribution and the large number of animals that have been poisoned by them, including cattle, horses, goats, and sheep, and also because of the difficulty of actually proving the existence of a poisonous principle in the plants themselves.

The loco plants have had a place in romantic literature, as it has frequently been claimed that they produce the same effect upon human beings as upon the lower animals, and it has been a popular subject for the short-story writer. None of these stories of "locoed" men, however, have any substantial foundation.

The word loco is from the Spanish, meaning crazy, and was given because of the supposed effect upon its victims. Loco plants have been heard of in practically all the open-range country of the West, except in the higher mountains, and there is no doubt that under the term loco disease a large number of ailments have been included. Experimental proof, however, has shown that there is a disease occasioned by the loco plants, with distinct symptoms and with a definite outcome.

WHITE LOCO, OR "RATTLEWEED" (OXYTROPIS LAMBERTI)

This is the most destructive of all the loco plants, not because of its greater toxicity but because of its wide distribution, extending from Alaska on the north to Mexico on the south, and from the Continental Divide to the western part of Minnesota. It poisons horses, cattle, and sheep

FIELD OF WHITE LOCO (OXYTROPIS LAMBERTI)

This landscape, taken in Montana, is a typical one and shows with what great abundance this plant grows under favorable circumstances. It grows in equal abundance in Wyoming and Colorado

OXYTROPIS BESSEYI

This plant, closely resembling the white loco, grows in the same regions, especially in Montana and Wyoming, in close proximity to the white loco, and is frequently considered a loco plant. Experimental work has proved that it is harmless. It can be distinguished from the white loco by the dark color of the flowers, and by the fact that it is more likely to grow upon the dry summits of the hills, in more sterile locations than those in which the white loco is found

PURPLE LOCO, OR TEXAS LOCO (ASTRAGALUS MOLLISSIMUS)

This plant is sometimes known as the true loco, and grows abundantly in Texas and New Mexico. It seldom injures any animals except horses, but is very poisonous to them

White Loco (Oxytropis lamberti).

Of all the loco plants the most destructive is the "white loco," or "rattleweed," *Oxytropis lamberti* of the botanists. This is not because of its greater toxicity, but because it grows in great abundance over a wide extent of territory and is poisonous not only to cattle, goats, and sheep but to horses. It is found in the Plains region east of the Rocky Mountains from Alaska to Mexico. Like all the loco plants, it belongs to the Leguminosæ or pea family, the family in which are found peas, beans, clovers, alfalfas, etc. It is a stemless perennial plant, living two or three years or more, and has a long root system which enables it to withstand conditions of drought. The leaflets of the compound leaves are slender, more or less hairy, and of an olive-green color. Thrifty plants are a foot or more in height.

The spikes of flowers are borne on stems extending above the leaves and are commonly of a prevailing white color, hence its name of white loco. The corolla, however, is frequently streaked with purple; sometimes the calyx is red; and sometimes, particularly in mountain regions, the whole corolla may be of a deep violet or purple color. All graduations in color may be found between these extremes. When the plants are in fruit the pods rattle as one hits them in walking, very closely imitating the rattle of a rattlesnake, hence the name "rattleweed."

Plate XV is a picture of the white loco as found in the plains of Colorado. Plate XVI shows a field of the plant in blossom. The latter picture was taken in the Yellowstone Valley of Montana, but it could easily be duplicated in Wyoming or Colorado.

It is evident that where the plant occurs in these great numbers such a thing as eradication is impossible except by plowing over the whole country. If animals are turned loose in such a region as this they certainly will have an opportunity to obtain an abundance of loco.

Astragalus drummondi.

In Plate XIX is given a picture of *Astragalus drummondi*, which occurs in many regions in connection with the white loco and is frequently considered a loco plant. The plant is readily recognized by its coarse stems and yellowish flowers, both the flowers and pods being somewhat dependent. Many people consider this a dangerous plant, but extensive experiments by the Department of Agriculture have shown that it is entirely harmless and need not be feared. The picture is given here only that stockmen may be able to recognize it as a plant which need not be avoided.

Oxytropis besseyi.

Plate XVII shows a picture of *Oxytropis besseyi*. This is a leguminous plant, rather common in the Yellowstone Valley, which is very closely allied to the white loco and is frequently mistaken for it. The flowers are of a deep-pink color, and the plant, while it grows in the same regions as the white loco, is found upon the arid barren summits of hills, the white loco growing most abundantly at slightly

lower levels. The two plants intermingle to some extent, but after a little experience one is able to distinguish between them, as there are certain noticeable differences in the leaves. *Oxytropis besseyi* is known in Montana sometimes as the red loco, because of the color of the flowers. Although the plant is closely related to the white loco and grows in the same regions, there is abundant experimental evidence that it is harmless. It should not be considered as a loco plant. The writer considers that the term "loco" should be applied only to such leguminous plants as have been proved to have poisonous properties.

Purple Loco (Astragalus mollissimus).

Astragalus mollissimus, popularly known as purple loco, woolly loco, and sometimes as Texas loco, is a plant that has been historically known as the true loco. It is probably the first plant which was recognized as a loco dangerous to livestock. It does not grow north of Nebraska, and perhaps is most abundant in the Panhandle of Texas, although it is found in adjoining regions of New Mexico, Colorado, Kansas, and in Nebraska. The leaflets are very hairy and are much broader than those of the white loco. The plant also has a true stem, while the white loco has sometimes been known as the "stemless loco."

Plate XVIII shows a very small plant of this loco. The flowers are not so conspicuous as in the white loco, and the corolla is of a deep-purple color. The pods are shorter, thicker, and of a deep-brown color. Large plants of purple loco may under favorable circumstances be about a foot in height and perhaps 2 feet in diameter. It does not commonly grow in the great abundance characteristic of the white loco, but there are sometimes fairly extensive fields. Where it grows in connection with the white loco the purple loco is more inclined to grow in depressions, while the white loco is found more abundantly at slightly higher levels. Purple loco is particularly destructive to horses; cattle may be poisoned by it, too, although this is rarely the case, perhaps because cattle do not eat it very readily.

Blue Loco (Astragalus diphysus).

Plate XX is a picture of *Astragalus diphysus*, known as blue loco, which is a type of a number of loco plants growing in the Southwest. These plants differ in their appearance very markedly from the white and purple locoes. The leaflets are small and of a deep-green color like alfalfa.

Closely allied to the plant illustrated are a number of species which there is every reason to consider as true loco plants and which it is incumbent upon stockmen to prevent stock from eating.

In past years the blue loco has been known mainly as a horse-poisoning plant, and has been responsible for heavy losses in Arizona. However, it will affect also cattle and sheep, and recently has caused much trouble with cattle.

Astragalus notoxys.

This loco, shown in Plate XXI, is a low, spreading plant which grows in considerable abundance in southern Arizona. It is thought

ASTRAGALUS DRUMMONDI.

This plant grows very abundantly in the same region as the white loco, and frequently is considered as one of the loco plants. Careful experimental work has proved that it is harmless.

BLUE LOCO (ASTRAGALUS DIPHYSUS).

This is a type of a number of loco plants growing in the Southwest, which are particularly destructive to horses. Experimental work has proved that this poisons both horses and cattle.

ASTRAGALUS NOTOXYS.

Low, spreading loco common in southern Arizona.

to be the cause of many deaths of cattle. While very little experimental work has been done upon it, it has been shown to be poisonous, and should be avoided.

Other Possible Loco Plants.

Popularly all plants resembling the locoes are called locoes. As shown on page 16, some of these are known to be harmless. On the other hand, there is good reason to think there are still a number of true locoes which have not yet been recognized. It is an interesting fact, too, that some of the plants closely related to the loco plants are distinctly poisonous to livestock, although they do not produce true loco symptoms.

Symptoms of Loco Poisoning.

All the loco plants produce similar effects. These symptoms appear only after a somewhat prolonged feeding upon the plant, and this fact has led to the failure of a great many feeding experiments with loco. Ordinarily the first symptom in a locoed animal is a loss of condition. This is followed by irregularities of gait and weakness which in many cases seems almost to amount to paralysis. The animal shows a lack of coordination in its muscular movements, due without doubt to the effect of the plant upon the central nervous system. Horses formerly gentle become uncontrollable and shy violently at imaginary objects or leap high over some slight obstruction. Generally speaking, a locoed horse can be neither led nor backed, and when put in motion can not easily be stopped or turned, but may continue until it runs against a fence or other obstruction.

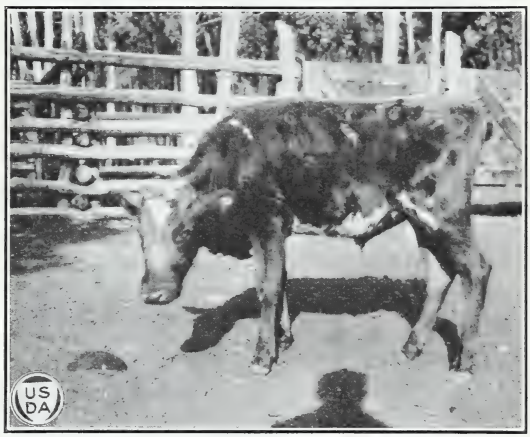

Fig. 14.—A steer poisoned by the blue loco (*Astragalus diphysus*).

Many animals acquire a liking for the plant to such an extent that they will eat nothing else. This, however, is not true in all cases. The animal, when affected, shows progressive emaciation and eventually starves to death. It is not at all unusual in a country where there are locoed cattle to see a steer standing off by itself, sometimes remaining in one position for hours, or even for days, and finally falling and dying without making any attempt to go elsewhere for either food or water.

In Figure 14 is shown a steer poisoned by the blue loco. Figure 15 is a picture of a steer in the last stages of loco poisoning from eating white loco. Figure 16 is a locoed range horse, probably affected by the blue loco. In Figure 17 are shown two horses

poisoned by the purple loco. These pictures show very well the lack of muscular coordination which is one of the striking symptoms in locoed animals.

The losses from loco plants have been enormous. Some owners have gone into bankruptcy, and in many cases it has been found impossible to run horses or cattle upon certain ranges.

FIG. 15.—A steer badly locoed by the white loco (*Oxytropis lamberti*).

TREATMENT OF ANIMALS POISONED BY LOCO.

It does not always follow that animals eat the plants in any very large quantity, for even in a place like that shown in Plate XVI cattle may be pastured for a long time without any of them becoming affected. The most important point in regard to the handling of domestic animals upon such a loco range, as will be emphasized later in this bulletin, is to see that they have an abundance of good feed. When the range contains in addition to the loco an abundance of grasses the number of locoed animals is very much reduced.

When the first symptoms of loco poisoning are observed, it is essential that the animals be removed to a place where they can not get the plants. Horses are very apt, after becoming slightly locoed, to continue eating the plant until they are absolutely worthless. It is always unsafe to turn a partly locoed horse upon a ground that is covered with the plant. The same is true in regard to cattle, only to a lesser degree. As soon as symptoms of loco poisoning are seen in cattle they should be removed from the open range and, if possible, put upon alfalfa pasture. All locoed animals are constipated, and the alfalfa has a tendency to relieve this condition.

FIG. 16.—A locoed horse in Arizona. The attitude is typical.

Generally speaking, if cattle are moved from the open range in time and fed upon alfalfa, the greater number of them will recover. After recovery it is well to put them upon the market as soon as possible, for if turned out upon the range again there is always a

CICUTA VAGANS

The species of Cicuta growing in the northwestern United States. Cicuta, commonly known to stockmen as parsnip, is the most poisonous of all our native plants, and grows in damp valleys and along irrigating ditches

CICUTA VAGANS

A young plant with the rootstock, and a longitudinal section of the rootstock. By the transverse chambers shown in the longitudinal section of the rootstock the Cicuta can readily be distinguished from any other plant growing in the same locality

possibility that they may become locoed a second time, with worse results than at first.

If the animals are valuable enough to justify the time spent in treating them, their recovery will be hastened, in the case of horses, by daily doses of 15 to 20 cubic centimeters (4 to 6 drams) of Fowler's solution, while cattle may be given hypodermic injections of strychnin. These doses should be continued for at least a month. Care should be taken in the use of strychnine, as locoed animals are very sensitive to its use. It is better that doses for cattle should not exceed three-twentieths or four-twentieths of a grain. Never, in the case of a large animal, should more than one-half grain be given.

In the case of locoed sheep upon the range, if the number is small, it is not profitable to spend any time or trouble with them. It is better to slaughter them immediately, as a locoed sheep will teach others the same habit. If, however, a number of locoed sheep can be separated and, like the cattle, be turned into an alfalfa field, most of them are likely to recover. Sheep may be helped by doses of one-twentieth grain of strychnine, but ordinarily, on account of the small value of individual animals, it is not profitable to spend the time which is necessary to insure their recovery.

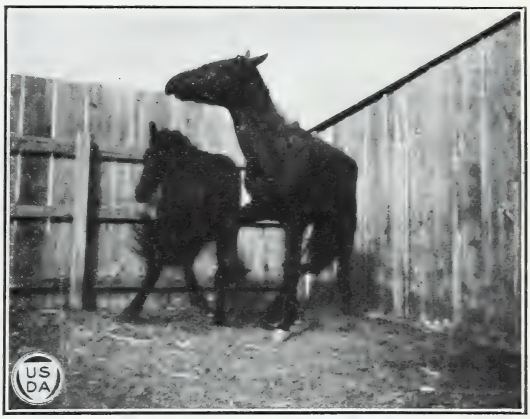

FIG. 17.—Locoed horses in western Nebraska, showing lack of muscular coordination.

In handling animals in a loco country it should be remembered that all domestic animals are more or less imitative, and loco eaters are likely to teach others to do the same thing. Therefore, so far as possible, all animals that have acquired the habit of loco eating should be separated from the others.

THE BUCKTHORN FAMILY (RHAMNACEÆ).

COYOTILLO (Karwinskia humboldtiana).

The coyotillo (*Karwinskia humboldtiana*) is a shrub growing in southwestern Texas which is known to be poisonous, although very little experimental work has been done upon it. In Figure 18 is shown the plant at the time of blossoming in early May, and Plate XXIV shows the form of the leaves and the fruit. The leaves are only slightly poisonous and the pulp of the fruit not at all. The seeds are very poisonous and affect all domestic animals. The earliest reports were of the poisoning of goats. A paralytic condition is produced, affecting especially the hind quarters, the disease in cattle being known as "limber leg." Cases of serious poisoning of children have also been reported.

THE PARSLEY FAMILY (UMBELLIFERÆ).

WATER HEMLOCK (SPECIES OF CICUTA).

The most poisonous of all the plants in the United States is, without any doubt, the Cicuta, which is most commonly known throughout the West as "parsnip," sometimes as "water hemlock." There are several species of Cicuta recognized by botanists, but they are very closely allied, and for the purpose of stockmen the description of one will serve for all. Plates XXII and XXIII show *Cicuta vagans*, the species which is common on the Pacific slope, while Plate XXV shows the stems and roots of the species growing farther east (*C. maculata*).

Cicuta is an umbelliferous plant growing in swamps and damp valleys and frequently very abundantly along irrigating ditches. A large number of umbelliferous plants occur in these localities, and it is difficult for one unacquainted with botany to distinguish Cicuta from similar but nonpoisonous plants. Probably the easiest way to distinguish the plant is by an examination of the rootstock. The Cicuta grows from a rootstock to which are attached roots which may be small, as shown in Plate XXIII, or may take the form of a group of thick, fleshy tubers, as shown in Plate XXV. In longitudinal section this rootstock shows more or less distinctly a number of transverse chambers, as shown in Plates XXIII and XXV. By this peculiarity of structure Cicuta can be distinguished from most plants growing in places where it is likely to be found.

FIG. 18.—A plant of coyotillo (*Karwinskia humboldtiana*) at the time of blossoming.

POISONING BY CICUTA.

It has been commonly thought that the tops of Cicuta when found in hay caused the loss of stock, but experimental work of the department has shown quite conclusively that the mature tops and seeds never occasion losses, although cases of poisoning have resulted from eating the young shoots in the spring. The rootstock and roots are violently poisonous and a very small quantity of these is sufficient to kill any animal that eats it. Probably all animals are susceptible to the effects of this plant. The losses of domestic animals are mainly of cattle which either obtain the rootstocks that have been plowed up along irrigating ditches or find them along watercourses in mountain valleys where they have been washed out by the high water.

COYOTILLO (KARWINSKIA HUMBOLDTIANA).

Showing the leaves and fruit.

WATER HEMLOCK (CICUTA MACULATA).

Stem and roots. This shows the fleshy tuberous roots which are characteristic of some species of Cicuta.

MENZIESIA GLABELLA.

One of the laurels growing in northwestern United States, which has been known to occasion heavy losses of sheep.

BLACK LAUREL (LEUCOTHOE DAVISIÆ).

This is one of the black laurels, and causes heavy losses of sheep in the Sierras.

Symptoms, Treatment, and Losses.

The symptoms of Cicuta poisoning are frothing at the mouth and most violent convulsions, which in a short time ordinarily end in death. Figure 19 shows a heifer in convulsions as the result of eating water hemlock.

When cattle are severely poisoned the convulsions are so violent that it is almost impossible to administer a remedy; in fact, no effective remedy is known, and death is almost certain to follow cases of severe poisoning by this plant.

It frequently happens that human beings, especially children, are poisoned by Cicuta, in which case if an emetic can be given promptly, so that the stomach is quickly emptied, recovery usually takes place. Because of the fact that ruminant animals can not empty the stomach by vomiting, this remedy can not be applied to them.

The losses from Cicuta poisoning are not ordinarily very heavy, but individual stockmen occasionally lose quite a number of animals.

Fig. 19.—Calf in convulsions resulting from poisoning by water hemlock (*Cicuta maculata*).

THE HEATH FAMILY (ERICACEÆ).

LAURELS.

Among the plants classed as laurels are a number which are important as poisonous plants and occasion heavy losses, more especially of sheep. All these plants contain a poisonous substance known as andromedotoxin. The following brief statements concern the laurels which are known to cause losses on the western ranges.

Menziesia glabrella.

Menziesia glabella, a shrub which grows in the mountains of the extreme Northwest, has been found to be distinctly poisonous to sheep. It is not known that many losses have occurred from eating this plant, but it was demonstrated in one case in Idaho that the plant was the cause of very heavy losses, and there is no doubt that when sheep in those regions are pastured on the north slopes where Menziesia is more likely to grow, and are short of other food, disastrous results may follow. Plate XXVI shows this plant in flower.

Black Laurel (*Leucothœ davisiæ*).

Leucothœ davisiæ, generally known throughout the Sierras as black laurel, is particularly destructive to sheep. It has thick, dark-green,

oval leaves and small white flowers in erect racemes, as shown in Plate XXVII, and grows to a height of about 3 or 4 feet. It is found in small patches at elevations from about 3,500 to 5,000 feet in the northern Sierras in California. While far from common, it is yet a very important plant because of its extremely toxic character. It has been stated that a single leaf will poison a sheep. This statement is probably exaggerated, but experimental work shows that very small quantities will poison sheep and that death may be produced by between 1 and 2 ounces.

The prominent symptoms are salivation, nausea accompanied with vomiting, depression, weakness, and irregular respiration. Figure 20 shows a slightly poisoned sheep.

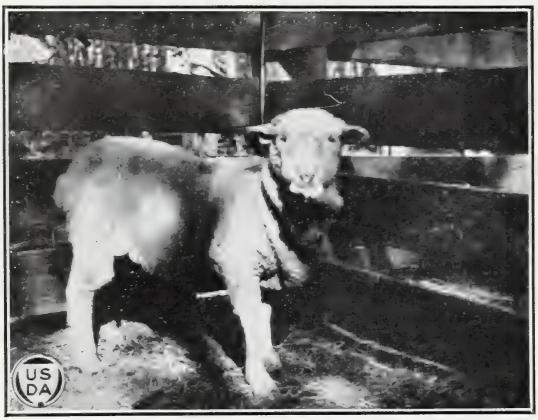

FIG. 20.—A sheep poisoned by black laurel (*Leucothoe davisiæ*), showing salivation.

LEDUM GLANDULOSUM.

Ledum glandulosum, illustrated in Plate XXVIII, is also known in California as black laurel and probably is not generally distinguished from *Leucothœ davisiæ* by the sheepmen, although it has a very different habit. It is rather widely distributed, being found not only in the Sierras and coast ranges in California, but also in Oregon, Washington, Nevada, and the Rocky Mountains. While no experimental work has been done with this plant, there seems to be no question that it causes serious losses of sheep in California.

RHODODENDRONS ALBIFLORUM.

Rhododendron albiflorum, illustrated in Plate XXIX, is common in the mountains of the Northwest and has undoubtedly caused some losses, although it is not very generally recognized as a poisonous plant. Preliminary experiments apparently show that it is more poisonous than Menziesia, but less so than the black laurel. Losses from this plant have been reported from the Columbia National Forest, in Washington, and from the Routt National Forest, in Colorado.

WHITE LAUREL (AZALEA OCCIDENTALIS).

The White laurel (*Azalea occidentalis*) is illustrated in Plate XXX. It is found in the coast ranges and the Sierras, growing at a slightly lower level than the black laurels, and causes considerable losses of sheep.

BLACK LAUREL (LEDUM GLANDULOSUM).

One of the black laurels which, together with Leucothoe, probably cause the major part of the losses of sheep in the Sierras.

RHODODENDRON ALBIFLORUM.

A laurel causing losses of sheep in the Northwest

WHITE LAUREL (AZALEA OCCIDENTALIS)

It grows at a lower elevation than the black laurels, and causes heavy losses of sheep in the Sierras

COMMON OR SHOWY MILKWEED (ASCLEPIAS SPECIOSA).

This plant is very slightly poisonous and probably causes no losses under range conditions.

THE WOOLLY-POD MILKWEED (ASCLEPIAS ERIOCARPA).

An exceedingly poisonous plant growing in western and southern California.

Symptoms of Laurel Poisoning.

The symptoms are practically the same in all cases of laurel poisoning. There is a salivation resulting in frothing at the mouth (fig. 20), nausea ordinarily accompanied with vomiting, depression, weakness shown by a staggering gait or inability to stand, and irregular respiration. Grinding of the teeth is frequently noticed in sick animals.

Treatment of Laurel Poisoning.

Little can be done in the way of remedial treatment. Anything that will aid in elimination will be of some benefit, and to this end purgatives may be given, such as Epsom salt in doses of 4 ounces. The main reliance, however, must be placed on prevention. Herders should learn to recognize and avoid the plants.

THE MILKWEED FAMILY (ASCLEPIADACEÆ).

MILKWEEDS (SPECIES OF ASCLEPIAS).

A large number of species of milkweed are poisonous and cause losses of livestock, especially of sheep.

Showy Milkweed (Asclepias speciosa).

Perhaps the most common of the milkweeds is the showy milkweed, *Asclepias speciosa*, shown in Plate XXXI. It is found in all of the States west of the Mississippi River. While it has poisonous properties, it is not particularly poisonous, is rarely eaten, and probably never causes losses of range animals.

Woolly-Pod Milkweed (Asclepias eriocarpa).

A broad-leafed milkweed *Asclepias eriocarpa*, known as the woolly-pod milkweed (Plate XXXII), which grows in California, is very poisonous and has caused heavy losses of sheep. A comparison of the plates will show that *A. eriocarpa*, while superficially resembling *A. speciosa*, has leaves of a very different form. The prominent symptoms of poisoning by woolly-pod milkweed are marked depression, loss of appetite, diarrhea, mucus in feces, lowered temperature, and rapid pulse. This is probably the most poisonous of all the milkweeds and is peculiar in that sometimes the serious symptoms do not appear until a considerable time after the plant has been eaten.

Whorled Milkweeds.

There are several species of whorled milkweed, plants with narrow leaves arranged more or less in whorls. Of these the most important is *Asclepias galioides*, found in Colorado, Utah, Arizona, and New Mexico, and extending into western Texas. This is illustrated in Plate XXXIII. It is poisonous to horses, cattle, and sheep, and has caused serious losses, especially of sheep.

Another whorled milkweed, *A. mexicana*, shown in Plate XXXIV, grows in the Pacific States and is especially abundant in some parts

of California. It is not so poisonous as *A. galioides*, but nevertheless has caused serious trouble.

The most characteristic symptom in acute cases of poisoning by the whorled milkweeds is the presence of most violent convulsions, sometimes accompanied by a very high temperature. In milder cases the animals do not exhibit convulsions, but stagger about, the weakness being most pronounced in the hind legs. This condition may be prolonged several days.

FIG. 21.—A sheep severely poisoned by woolly-pod milkweed (*Asclepias eriocarpa*).

In Figure 21 is shown a sheep poisoned by the woolly-pod milkweed; and in Figure 22, a sheep in violent convulsions as the result of poisoning by the Mexican whorled milkweed. Figure 23 shows a sheep poisoned by the Great Plains whorled milkweed (*Asclepias pumila*); the animal has difficulty in standing, as indicated by the bracing apart of the hind legs. In Figure 24 is shown a horse poisoned by *Asclepias galioides*. In spite of the extreme illness, this animal recovered.

OTHER BROAD-LEAFED MILKWEEDS.

Recent studies have shown that there is danger from other broad-leafed milkweeds. For example, *Asclepias fremontii*, shown in Plate XXXV, and found in northern California, is as poisonous as the woolly-pod milkweed. Some, apparently, are harmless. It is difficult for one not well posted in botany to distinguish between these plants, and, in the present state of our knowledge, it is best that the stockman should prevent extensive grazing upon any of these plants.

FIG. 22.—Sheep poisoned by Mexican whorled milkweed.

MILKWEEDS NOT SOUGHT BY ANIMALS.

The milkweeds are distasteful to animals and are never eaten by choice. When, however, hungry stock are confined to areas where

WHORLED MILKWEED (ASCLEPIAS GALIOIDES).

This plant is very poisonous to cattle, horses, and sheep, and has caused some extremely heavy losses of sheep in the West and Southwest.

THE MEXICAN WHORLED MILKWEED (ASCLEPIAS MEXICANA).

This species is especially abundant in parts of California.

ASCLEPIAS FREMONTII.

A very poisonous broad-leafed milkweed of northern California.

82963°—24——4

milkweeds are abundant, they will eat them for lack of better forage and frequently with disastrous results. There is little danger from any form of milkweed so long as animals are well fed.

There is no known successful way of treating milkweed poisoning, except by prevention.

FIG. 23.—A sheep poisoned by the Great Plains whorled milkweed (*Asclepias pumila*). The weakened condition of the hind legs is noticeable, as in the Mexican-whorled-milkweed case.

THE COMPOSITE FAMILY COMPOSITÆ).

COCKLEBUR, CLOTBUR (SPECIES OF XANTHIUM).

The cocklebur or clotbur, shown in Figure 25, is represented by a number of species (*Xanthium* spp.), is very widely distributed, and has been the cause of losses of cattle and swine in many localities, especially in Oklahoma, Texas, and New Mexico. While long supposed to be poisonous, it is only very recently that definite experimental proof of its toxic character has been obtained.

It is said that the burs produce mechanical injury by irritating the alimentary canal or by becoming matted together to form balls which cause intestinal obstruction. It is claimed that there have been cases of the lodging of burs in the throat. Some recent authors have stated that the only injury produced by cockleburs is the mechanical effect. There is now, however, positive proof of poisoning of swine, sheep, cattle, and chickens. There are reports also of the poisoning of horses. All the poisoning is by the young plant in the cotyledon stage. Young pigs are especially susceptible to the plant and have been lost in great numbers. Figure 26 shows a pig fatally poisoned. While the plant has been shown to be poisonous to sheep, there have been no reports of losses of sheep under range conditions, but the burs produce trouble by becoming tangled in the wool and causing a considerable dockage.

FIG. 24.—A horse poisoned by the western whorled milkweed (*Asclepias galioides*). The violent convulsions are characteristic of poisoning by the whorled milkweeds.

REMEDIES.

Based on the statement that pigs fed on fresh milk are not poisoned, experimental work has shown that beneficial results follow the administration of oils or fats. For this purpose linseed oil, bacon grease, or lard can be used.

WESTERN SNEEZEWEED (Helenium hoopesii).

FIG. 25.—A branch of a common cocklebur (*Xanthium* sp.), showing the form of the leaves and fruit.

Western sneezeweed (*Helenium hoopesii*), sometimes called "yellowweed" by the stockmen, is found in great abundance on the sheep ranges of the Wasatch Mountains in Utah, especially in localities where the range has been heavily grazed. The plant is distributed in greater or less numbers from Wyoming in the North to New Mexico and Arizona in the South, and as far west as California, but it is in Utah that it has become prominent as a poisonous plant.

The plant, shown in Plates XXXVI and XXXVII, is a stout perennial composite, growing to 2 or 3 feet in height, with thick deep-green leaves. The rays of the flower are of an orange color and the disk a brownish orange; the blossoming period in the Wasatch Mountains ends the middle or last of August. Its range in elevation is from 7,000 to 10,500 feet.

FIG. 26.—A young pig fatally poisoned by cocklebur. The picture was taken shortly before death.

Under ordinary range conditions the western sneezeweed seems to be dangerous only to sheep although there have been some fairly well-authenticated losses of cattle from this plant. It has been found to be the cause of what is known in Utah as the "spewing sickness" of sheep, from which there have been quite heavy losses.

SYMPTOMS OF POISONING BY WESTERN SNEEZEWEED.

The marked symptoms of sneezeweed poisoning are depression, weakness, salivation, and nausea accompanied with vomiting; this

WESTERN SNEEZEWEED (HELENIUM HOOPESII)

This plant, especially in Utah, causes serious losses of sheep

WESTERN SNEEZEWEED (HELENIUM HOOPESII).

The picture shows how thickly it grows where land is heavily grazed.

BURRO WEED (BACCHARIS PTERONIOIDES).

The female plant in blossom.

latter symptom is so prominent as to have given the disease its popular name. Diarrhea is common, and bloating is a prominent symptom in the animals poisoned on the range. The poison is cumulative, and its effects continue for a long time.

Figure 27, shows a sheep poisoned by *Helenium hoopesii* at a time when nausea is very apparent, and Figure 28 shows a steer in the act of vomiting as the result of feeding on this plant.

FIG. 27.—A sheep poisoned by western sneezeweed (*Helenium hoopesii*). Its attitude shows that it is nauseated.

TREATMENT FOR SNEEZEWEED POISONING.

No medical remedy for sneezeweed poisoning has been found. It is the custom of sheepmen on the Wasatch Mountains, when their sheep are found to be "spewing," to take them to lower altitudes on "browse range," when their condition is improved. It is recognized, however, that this treatment does not bring about a real cure. It is important that herders should recognize the plant and so far as possible avoid ranges or parts of ranges where it is especially abundant. Generally speaking, when sheep are found to be suffering from this plant it is because they have been eating it for some time, and perhaps a single large feeding may have precipitated the trouble, which is mainly due to the accumulated effect of prolonged feeding.

FIG. 28.—A steer which has eaten western sneezeweed and is suffering from severe vomiting.

BACCHARIS PTERONIOIDES.

Baccharis pteronioides, *shown in* Plates XXXVIII and XXXIX, is a spreading shrub from 1 to 2 feet in height, found in western Texas, the southern portions of New Mexico and Arizona, and in Mexico. The tips of the young branches are sticky. The leaves are small, from one-eighth to three-quarters inch long, and grow in dense clusters. The flowers are in bell-shaped heads terminating the branchlets. The staminate and pistillate flowers are on different plants. The white pappus of the pistillate flowers makes the plants, when in blossom, quite conspicuous. The plants may live at altitudes

of from 4,000 to 7,600 feet, but are more commonly found between 5,000 and 6,000 feet.

There is good reason for thinking that this plant is responsible for many losses of cattle from October to midwinter, at a time when other forage is scarce. Experimental work has shown definitely that it is poisonous to sheep, the toxic dose being about 1 pound for a 100-pound sheep. Care should be taken that stock, especially when poorly nourished, should not graze to any extent upon this plant.

From what is known of *B. pteronioides*, it seems that it would not be difficult to remove it from a range, as it is local in distribution and easily destroyed by a mattock.

WOODY ASTER (Xylorhiza parreyi).

The woody aster (*Xylorrhiza parreyi*), shown in Plate XL, occurs in great abundance in certain regions in Wyoming, and has been accused of causing losses of sheep in those localities. There appears to be no doubt that the plant is poisonous. It is a fibrous plant, however, and is very distasteful to sheep under ordinary circumstances, so there is very little danger from it, provided the sheep are kept in a region where sufficient feed is obtainable.

FIG. 29.—A sheep poisoned by rayless goldenrod (*Isocoma wrightii*).

COLORADO RUBBER PLANT, OR PINGUE (Hymenoxys floribunda).

The Colorado rubber plant, or pingue (*Hymenoxys floribunda*), shown in Plate XLI, is confined to the northern part of New Mexico and the southern part of Colorado and Utah, and in certain localities grows in very great abundance. Its asterlike flowers are quite conspicuous, and the plant is readily distinguished from other similar plants because of the dark golden-yellow color of the flowers. The rubber plant has had a good deal of advertising because it contains a certain amount of rubber and has been the subject of commercial exploitation. It is claimed, especially in southern Colorado and northern New Mexico, that sheep feeding on this plant late in the winter suffer severely.

Experimental work has proved that the plant is poisonous to sheep, but it has been found difficult, under corral conditions, to make them eat it. Field observations have shown that in the localities where animals are reported to have suffered, the sheep in the latter part of the winter are frequently kept under conditions closely approaching starvation, and at such times doubtless, by force of circumstances, they eat more of the plant. It is doubtful whether there would be any loss from this plant if bands were properly fed.

BURRO WEED (BACCHARIS PTERONIOIDES).

The male plant in blossom.

WOODY ASTER (XYLORRHIZA PARREYI).

The woody aster has been considered to cause losses of sheep in Wyoming. It is probable that sheep eat it only when there is a lack of other forage.

COLORADO RUBBER PLANT OR PINGUE (HYMENOXYS FLORIBUNDA)

For a long time the Colorado rubber plant has been believed to cause losses of sheep in northern New Mexico and southern Colorado

RAYLESS GOLDENROD (Isocoma wrightii).

In the Pecos Valley in New Mexico and Texas there has been for many years a disease of animals known as milk sickness, alkali disease, and trembles. It was noted especially in cattle, and, because the disease may be conveyed through the milk, not only caused losses by death, but seriously interfered with the dairy business. For a time it was supposed to be a contagious disease, but recently it has been shown that it is produced by *Isocoma wrightii*, popularly known as the rayless goldenrod or jimmy weed. While the most serious effects of the weed in the Pecos Valley have been upon cattle, it will poison also horses and sheep.

The plant is shown in Plate XLII. It is a perennial, growing ordinarily to a height of 2 feet, but it may reach 4 feet or more. It is very abundant in some localities, frequently making a thick hedge along ditches.

One of the most prominent symptoms is the muscular trembling which has given rise to the name "trembles" as applied to the disease. It has been shown that sometimes the offspring are poisoned by the mother's milk.

Figure 29 shows a sheep poisoned by rayless goldenrod. This animal trembled violently and could stand only a minute or two. In Figure 30 is a steer in the last stages, shortly before death.

FIG. 30.—A steer poisoned by rayless goldenrod (*Isocoma wrightii*); just before death.

It is important that stockmen should make certain that their animals get no large quantity of the plant. If animals are found eating it, they should be removed immediately to locations where there is none. In the early stages of the disease animals recover very quickly if put on good pasture.

The plant is rather easily destroyed by grubbing out to a depth of 2 or 3 inches, and thoroughly cleared pastures remain clear for a long time.

Another rayless goldenrod, *I. coronopifolia*, found in southern Arizona, is thought to produce the same harmful effect as the *I. wrightii*, but there has been no experimental work to confirm this belief.

FERN.

The common bracken fern, *Pteris aquilina*, which is illustrated in Plate XLIII, should be mentioned here as one of the poisonous plants, although the losses from it are probably not large. It has long been known abroad that the fern is poisonous to cattle and horses. There have been comparatively few reports in this country

of such losses, and those are largely confined to the Northwest. There is no doubt that ferns will poison both cattle and horses, and probably sheep, and care should be taken that hungry animals do not have an opportunity to consume any large quantity.

PREVENTION OF LOSSES.

In Farmers' Bulletin 720 attention was directed to the fact that most of the losses from poisonous plants occur at times when the animals are short of feed, and it was suggested that the larger part of the stock poisoning is indirectly due to scarcity of proper forage. This fact of the intimate relation of scarcity of feed to stock poisoning can not be too strongly impressed upon the people who handle range animals in the West.

There is apparently a popular idea that range animals will voluntarily seek out poisonous plants and eat them by preference. It may be stated as a general fact that this is not true. Animals seldom eat poisonous plants except as they are driven to do so by lack of other food. Almost all poisonous plants are actually distasteful to livestock and under ordinary circumstances will be avoided. The only exception to this, perhaps, is the group of loco plants. Animals do frequently acquire a taste for loco and under some circumstances will eat nothing else, even in the presence of other forage; and yet the initial feeding in the case of loco plants is almost invariably brought about by scarcity of food.

It has long been known that loco eating is ordinarily commenced in the winter season or in the early spring when the loco plants are green and luscious, and before the grass has started. The loco plants at that time are the most prominent plants on the plains, and animals commence to eat them because of lack of other food. Many animals after feeding upon loco a short time acquire a liking for it and will continue to eat it even in the presence of an abundance of other food. This is not true, however, of all loco-eating animals, for there are very many which, after the grass has started, will leave the loco and will recover entirely from the effects which have been produced by the preceding feeding.

In the matter of the other plants, the relation between starvation and the eating of the poisonous plant is still more marked. For instance, the larkspurs spring up immediately after the snow leaves the mountains and grow much more rapidly than the surrounding grasses, and if cattle are allowed to go to the upper ranges before the grasses have had a fair start, they find already occupying the ground the succulent larkspur plants in large numbers. Sometimes the cattle come from dry winter feed and are anxious to gorge themselves with any green material they find. Under such circumstances if they come upon a field of larkspur they frequently eat enough to produce fatal consequences. Later in the season there is very much less danger from larkspur because of the abundance of other food. If, however, cattle are driven from one range to another and the trail passes through a mass of tall larkspur, it is not at all unusual for the hungry animals to grab hastily at the plants, and this may result in disastrous consequences. Under such circumstances it is important that the cattle shall not be driven rapidly, for if driven rapidly they

FIG. 1.—RAYLESS GOLDENROD (ISOCOMA WRIGHTII).

A group of plants late in the fall.

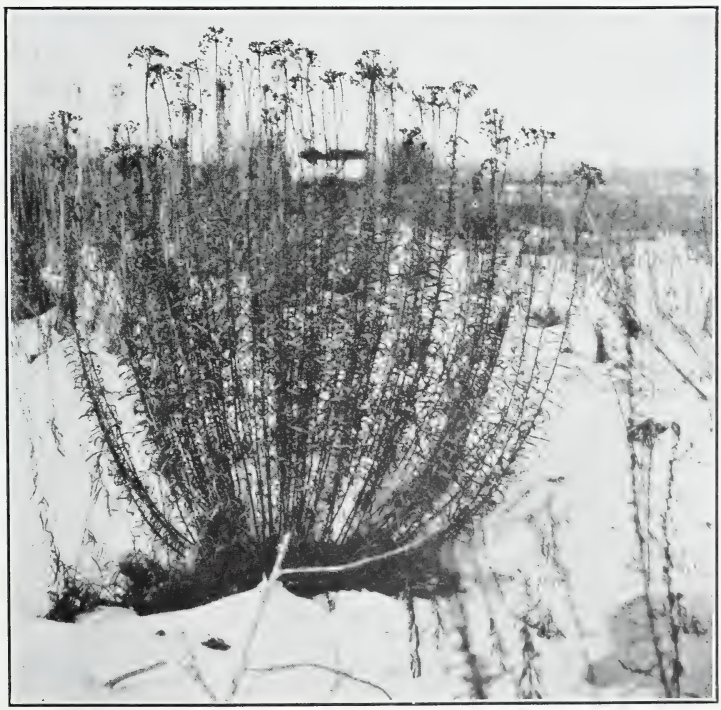

FIG. 2.—RAYLESS GOLDENROD (ISOCOMA WRIGHTII).

A plant as seen after snowfall.

COMMON FERN (PTERIS AQUILINA).

The common fern, particularly in the regions of the Northwest, sometimes causes losses of horses and cattle.

will snatch all the more. They should also have been thoroughly fed before going upon such a drive.

This has been illustrated in certain places in Colorado, where it is customary to drive cattle from one range to another, and for years there were always heavy losses. In the old days it was the custom to gather the cattle together and rush them as rapidly as possible through the place where the tall larkspur was growing. Losses invariably occurred. In recent years, instead of gathering the cattle together they have been put through the drive in small numbers and have been allowed to feed before starting. They are not driven rapidly. Under such conditions no losses have occurred.

It is also evident, from what has been said earlier in this bulletin, that if cattle can be kept off fields of larkspur until after the plant has blossomed, little trouble may be expected. This method has been employed for many years in certain regions in Colorado, where it is a common practice to "ride for poison," as it is called; that is, the herders ride and keep the cattle down from the higher ranges until the larkspur has blossomed and matured, after which there is no further danger. The same thing has been accomplished in certain regions by putting up drift fences which are designed to keep the cattle on the lower ranges until the danger is past. There are valleys known as death traps for cattle. Frequently it will be found that in these valleys the tall larkspur is thriving in large clumps, and cattle drifting in will feed freely upon it. It is often possible under such conditions to clear out this larkspur, or enough of it so there will be no danger. In order to kill the plants, the roots of most of the species should be cut off at least 6 or 8 inches below the surface.

Deaths from Cicuta poisoning rarely occur except in the case of animals that are almost in a starving condition. If very hungry animals are turned loose upon a range, and they find a number of Cicuta roots lying beside a ditch or along a mountain stream, and there is nothing else to eat, they eat these roots, of course, and death follows.

The losses of sheep from death camas (Zygadenus) occur under very similar conditions to those of cattle from larkspur. The grassy death camas grows very early in the spring. It precedes the grasses in its growth and is present in a succulent condition at a time when other forage is extremely scarce. Inasmuch as it occurs frequently in large masses, if sheep are trailed over these places they are liable to get enough to cause heavy losses. It is particularly important in the handling of sheep in such localities that, if possible, they be grazed in loose order. In fact, this is true of the handling of sheep under all circumstances. When the animals are massed together they will eat everything in their course, and, because of jealousy, will take particular pains to get every available plant. If, on the other hand, they are kept in loose order and spread widely over the range, they are much less likely to eat any poisonous plant.

This applies equally well to lupine poisoning. When sheep are allowed to feed freely upon a lupine patch and are moved without any haste, no harmful results will occur. If, however, they are massed together and driven in close formation over such a patch, they are almost certain to be poisoned if the plants are in pod at the

time. A large number of specific instances have been noted. At one place in Idaho, for instance, where losses have occurred repeatedly, it was found that the sheep were trailed in a narrow space through a patch of lupine. The remedy in such cases clearly is to see that the sheep, when it is necessary to trail them through a patch of lupine, are drifted rather than driven, and that they are well fed when they come upon the lupine area. It seems probable that intelligent handling of bands of sheep may reduce to almost nothing the losses occasioned by death camas and lupine. If, however, hungry sheep come in contact with fields of death camas in the spring, or with fields of lupine in the late summer and in the fall, at a time when the plants are bearing pods, fatal results must be expected.

In one locality in Oregon an instance of this character occurred in the summer of 1914, when something like 4,000 sheep which had been driven rather rapidly along a trail where forage was scarce were turned into a 10-acre pasture on which there was little but sagebrush and lupine, the lupine at that time being in pod. About 400 out of the 4,000 sheep died. Similar instances might be cited in a large number of places. Sometimes successive bands of sheep are driven over a trail, several going without any loss whatever; then one band may suffer heavily, while others following are not harmed. The explanation of these cases seems to be that the first animals going over the trail avail themselves of all the useful forage. The succeeding animals, finding nothing suitable for food, take the poisonous plants, which may be wild cherry or lupine, or, in the case of cattle, larkspur. The animals which are poisoned may exhaust the supply, even of the poisonous plants, so that succeeding bands are not poisoned and get across the trail safely provided they do not fall from actual starvation.

It follows from these facts that it is very undesirable to keep sheep for any length of time upon the same bedding ground. This has been shown to be bad for the range on general principles, but it is also rather risky for the sheep themselves, for if animals go out from the same place day after day and return at night they will eat everything that is available along the route. In such cases, if there are poisonous plants to be obtained, the animals are pretty apt at some time to get hold of them, with disastrous results. This has been very clearly shown in a case of Menziesia (laurel) poisoning, in which animals were bedded on a forest range for five nights in the same place; the animals were safe for the first two nights, but after that there was heavy loss. At the same time a band that was wandering about without a herder in the same region was uninjured.

It can not be too strongly impressed upon persons handling sheep upon the range that the sheep should be allowed to graze as far as possible under strictly natural conditions. By this is meant that they should be allowed to go freely, separated from each other, moving slowly, and not permitted to graze over and over upon the same ground. The so-called blanket system of herding, which is advocated by the Forest Service, in addition to the fact that it aids in the conservation of the range, will also without any doubt reduce the losses from poisonous plants to a minimum, if it does not entirely do away with them.

In conclusion, it should be stated that, generally speaking, very little must be expected from medicinal remedies to reduce the losses from poisonous plants. It is true that such remedies will help in the case of locoed animals and will save life in the case of larkspur poisoning of cattle. Generally speaking, however, the reliance should be placed, not in remedies but upon prevention. Animals must be so well cared for that they will not be tempted to eat poisonous plants. Something may be done in the way of eradication, as was indicated under the discussion of larkspur. Larkspur can doubtless be eradicated within a limited area. The locoes in pastures can be eradicated with very little difficulty, but upon the open range dependence must be placed upon avoidance rather than eradication. Death camas, too, does its harm upon the open range, and there it occurs in such large masses that eradication is impossible. In the matter of Cicuta, farmers, without doubt, may accomplish much by digging it up along their irrigation ditches, and this practice is usual in a great many localities. But in the main the losses from poisonous plants must be prevented by careful handling of the herds, remembering always that animals are not likely to eat poisonous plants by preference, but that under starvation conditions they may be driven to the use of such material for forage with most disastrous results.

PUBLICATIONS ON STOCK-POISONING PLANTS.

PUBLICATIONS AVAILABLE FOR FREE DISTRIBUTION BY THE DEPARTMENT OF AGRICULTURE.

Eradication of Ferns from Pasture Lands in Eastern United States. (Farmers' Bulletin 687.)
Prevention of Losses of Livestock from Plant Poisoning. (Farmers' Bulletin 720.)
Eradicating Tall Larkspur on Cattle Ranges in the National Forests. (Farmers' Bulletin 826.)
Larkspur or Poison Weed. (Farmers' Bulletin 988.)
The Loco-Weed Disease. (Farmers' Bulletin 1054.)
The Stock-Poisoning Death Camas. (Farmers' Bulletin 1273.)
Astragalus tetrapterus, a New Poisonous Plant of Utah and Nevada. (Department Circular 81.)
A New Sheep-Poisoning Plant of the Southern States. (Coffee Bean.) (Department Circular 82.)
Sweet-Clover-Seed Screenings not Injurious to Sheep. (Department Circular 87.)
The Whorled Milkweed, a Plant Poisonous to Livestock. (Department Circular 101.)
The "Alkali Disease" of Livestock in the Pecos Valley. (Department Circular 130.)
Woolly-Pod Milkweed: A Dangerous Stock-Poisoning Plant. (Department Circular 272.)
Greasewood as a Poisonous Plant. (Department Circular 279.)
Livestock Poisoning by Cocklebur. (Department Circular 283.)
The Cause of the "Spewing Sickness" of Sheep (Western Sneezeweed.) (Bureau of Animal Industry Leaflet A–9.)
Cicuta (Water Hemlock) as a Poisonous Plant. (Bureau of Animal Industry Leaflet A–15.)
White Snakeroot or Richweed (*Eupatorium urticaefolium*) as a Stock-Poisoning Plant. (Bureau of Animal Industry Leaflet A.I.–26.)
Oak Poisoning of Livestock. (Bureau of Animal Industry A.I.–32.)
Notes on Larkspur Eradication on Stock Ranges. (Bureau of Animal Industry Leaflet A.I.–34.)

82963°—24——5

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Larkspur Poisoning of Livestock. (Department Bulletin 365.) Price, 25 cents.
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Stagger Grass (*Chrosperma muscaetoxicum*) as a Poisonous Plant. (Department Bulletin 710.) Price, 5 cents.
Oak-Leaf Poisoning of Domestic Animals. (Department Bulletin 767.) Price, 10 cents.
The Whorled Milkweed (*Asclepias galioides*) as a Poisonous Plant. (Department Bulletin 800.) Price, 15 cents.
Poisonous Properties of the Whorled Milkweed *Asclepias pumila* and *A. verticillata* Var. Geyeri. (Department Bulletin 942.) Price, 10 cents.
Western Sneezeweed (*Helenium hoopesii*) as a Poisonous Plant. (Department Bulletin 947.) Price, 10 cents.
The Mexican Whorled Milkweed (*Asclepias mexicana*) as a Poisonous Plant. (Department Bulletin 969.) Price, 5 cents.
The Death Camas Species, *Zygadenus paniculatus* and *Z. elegans*, as Poisonous Plants. (Department Bulletin 1012.) Price, 10 cents.
The Woolly-Pod Milkweed (*Asclepias eriocarpa*) as a Poisonous Plant. (Department Bulletin 1212.) Price, 5 cents.
The Meadow Death Camas (*Zygadenus venenosus*) as a Poisonous Plant. (Department Bulletin 1240.) Price, 5 cents.
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